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ARDUINO BASED SELF-BALANCING SEGWAY

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Abstract - *In this paper we are focused on building a prototype that demonstrates the working of a self-balancing segway. It is a two wheel device which can balance itself as well as a certain amount of weight on it. It can move forward or backward based on the inclination of the body of the rider. In this project we have used the MPU6050 module consisting of the gyroscope and accelerometer together to sense the angle of inclination which is processed by the arduino. It comes with a battery level indicator and is also capable of responding to remote sensors which is implemented here using HC-05 bluetooth module. This device serves as a mode of transport for a single person and is completely eco-benevolent since it uses batteries that can be recharged.*

Key Words: **Self-balancing, MPU6050, Battery level marker, HC-05 module, eco-benevolent**

1. INTRODUCTION

A segway is a two wheeled vehicle which was introduced by Dean L. Kamen in 2001. It can self-balance itself as well as the weight of the rider. It is provided with a control handle bar, vertical to the platform, which is pushed front or pulled back and accordingly the motion of the segway is noticed. The device is primarily driven by the dynamics of the rider either forward or backward. This is an eco- friendly mode of transport for short distances since no fuel is consumed and rechargeable batteries are used instead. A segway consumes very less space and helps reduce the extreme traffic to quite some extent. In our project, the prototype demonstrates the mechanism of the segway by balancing itself. A rider's motion makes changes in the angle of inclination of the device which is sensed by the MPU6050 and sends the data to the arduino which in turn controls the motion of the segway. For the rider's convenience, we have also introduced remote sensing, implementing it using the HC-05 bluetooth module. Thus a rider can access his/her vehicle from a certain distance. This device self- balances based on the inverted pendulum principle.

1.1 Inverted Pendulum Principle

An inverted pendulum is usually the base of all self-balancing mechanisms. It requires assistance to stay perpendicular to the base it is attached to. An original pendulum is stable because it hangs downwards but an inverted one, being forced against gravity, is quite naturally unstable and needs to be kept upright by some mechanism. The mass, to which it is attached, when moves forward or backward horizontally, the pendulum fails to stay upright in the same perpendicular position to the mass. To keep it in that state we need to apply a certain amount of torque at the center of it and make sure it stays upright by moving the whole thing forward or backward. This is the principle used for a self-balancing mechanism.

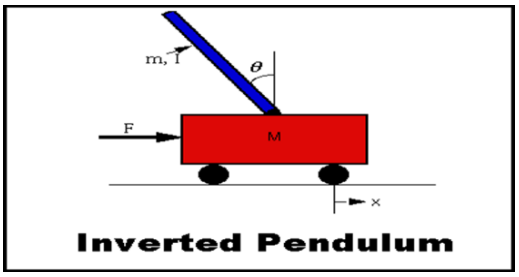

Fig -1: Inverted Pendulum

1.2 Objective

This project is concentrated upon building a prototype of a segway that can self-balance itself and its rider while in motion. It causes zero pollution by using battery as power source and consumes space almost that of its rider. The device can be accessed from a distance using remote sensing mechanism. Thus it serves as a smart way of transport within a short distance.

2. METHODOLOGY

The block diagram shown below consists of all the important blocks that are needed for the working of this prototype. The source of power is a rechargeable battery. The sensor unit is the MPU6050 block which has both gyroscope and accelerometer to sense the axis of tilt.

As a rider moves front or back the angle of inclination is sensed by the MPU6050 and the data is given to the arduino.

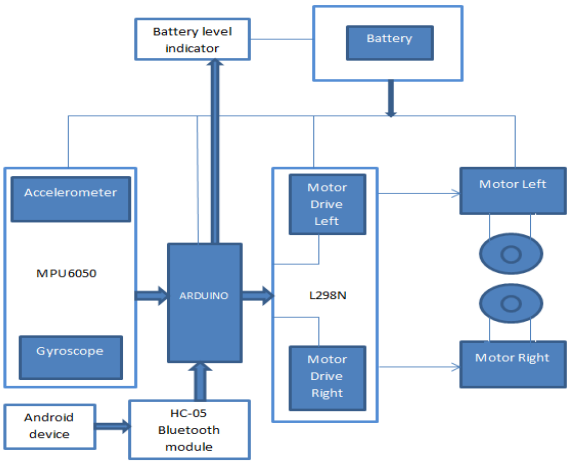

Fig -2: Block Diagram

By reading the data if the control unit feels that the device is falling out of balance then it instructs the L298N motor driver so that it can direct the motors. The motors in turn control the wheels. Therefore, the balance is maintained as the device balances itself. All the components i.e. the MPU6050, motor driver, HC-05 module are all interfaced with the arduino in order to run the device. To make sure of the convenience of the rider, we have introduced the concept of remote accessing using the Bluetooth module. Therefore, one can access his/her vehicle from a distance using this method of communication which does not need wires. Since it is a prototype of a Segway that is used for transportation of humans, thus we have also introduced an indicator to notify the battery left.

3. COMPONENTS

3.1 Arduino Uno

An Arduino uno is a platform which can be interfaced with other components to control the working of a device. It is compatible with several operating systems like Windows, Mac, linux etc. It consists of digital I/O pins which are 14 in number and can be used as per the requirement of the project. This is a simple board for beginners and can be further extended by experts according to their need. Arduino uno requires a 5v voltage for operation and also a USB connection to interface other components. In our prototype we use arduino to interface Bluetooth module, motor driver, MPU6050. We have constructed a battery level indicator which calculates the level of the battery using arduino and then arduino decides based on the algorithm whether the battery is full charged, or medium, or drained and then directs the respective LED to glow in this case Green , Yellow or Red.

Fig -3: Arduino uno

3.2 MPU6050

MPU6050 is a module which consists of a gyroscope and an accelerometer together in it. Both are 3-axis micro electro-mechanical systems.

Fig -4: MPU6050

This is the sensor module which senses the angle of inclination of the rider and hence the device while in motion. It then sends this data to the arduino to process it and balance the device as required. This module takes in a supply voltage of 3.3-5V.

3.3 L298N Motor Driver

L298N motor driver is a high voltage and high current dual H-bridge, called so for the structure of its circuit. It consists of an onboard 5v voltage regulator and is quite pockets friendly module. This driver module is used to control two motors bi-directionally.

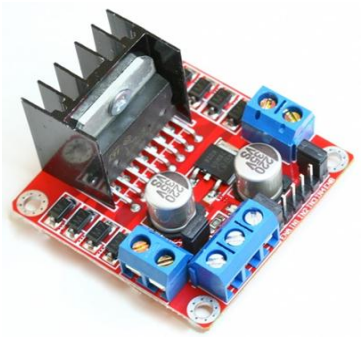

Fig -5: L298N Motor Driver

3.4 Bluetooth Module (HC-05)

HC-05 which is the bluetooth module is used for accessing the device by means of wireless technology. This module functions on the basis of master and slave principal. The configuration of master is implemented using attention commands. This can be extended using Global positioning system.

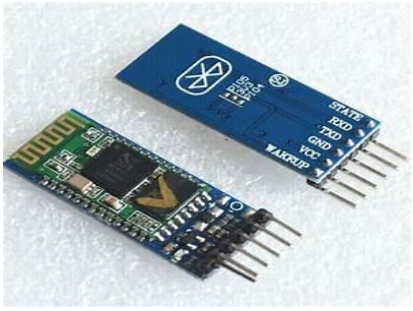

Fig -6: Bluetooth Module (HC-05)

3.5 Geared Direct current Electrical Motor

A geared direct current electrical motor is driven by the motor driver to rotate both clockwise and anti-clockwise and in turn rotate the wheels. They require a certain power to be driven. Here we have used brush-less motors because they have a comparatively lower maintainance and mechanically less complex.

Fig -7: Geared Direct Current motor

4. RESULT

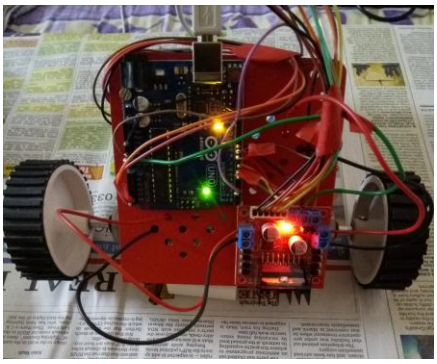

Fig -8: Prototype

5. CONCLUSION

The end result of the study results in a prototype of a Segway, that includes basic features like self-balancing, rechargeablility, battery level indicator and leisure features like remote sensing. This prototype gives a vision of future transportation where fuel is going to be problem and so is population. Our study is based on finding a solution to these problems and thus making our prototype a futuristic transportation medium. This prototype offers remote sensing which upscales its value and provide easy remote access from anywhere (within a distance of 10 mts, which can be extended with use of different wireless technology). The self-balancing mechanism is achieved using a proportional-integral-derivative controller which is set up manually while coding. The values of proportional gain , integral gain and derivative gain is attained by trial and error method. These values determine the stability factor of this segway model.

FUTURE SCOPE

Since our study focuses on constructing a prototype therefore it has few limitations that can be improved in future.

1] Greater RPM and Torque can be used in direct current electric motor for greater load and speed.

2] The motor driver can be changed to higher powered driver, as we are making a prototype we dont need high voltage driver but an actual product would need a greater powered motor driver .

3] Instead of manually setting up proportional gain , integral gain and derivative gain we can use PID controller as a component to avail extra flexibility and quick response time.

4] One can make use of two 3-axis gyroscope(instead of one) to attain better angle precision.

5] The wireless technology can be changed for greater range coverage.

REFERENCES

[1] Hau- Shiue Juang and Kai-Yew Lum, “Design and control of a two wheel self-balancing robot using the arduino microcontroller board”, IEEE International Conference on Controls and Automation, China, June 2013

[2] Wei An and Yangmin Li, “Simulation and Control of a Two-Wheeled Self-Balancing Robot”, IEEE International Conference on ROBIO, December 2013

[3] Mayukh Sharma, Rahul Sharma, Vikrant Sinha, Kshitj Singh, Shakil Tadavi, “Segway- The Human Transporter”, IJIRST, Volume 1, Issue 11, April 2015.

[4] Mr. Velaji Hadiya, Mr. Aakash Rai, Mr. Sushant Sharma, Ms. Ashwini More, “Design and Development of Segway”, IRJET, Volume 3, Issue 5, May 2016.